FACILITY FOR STUDY OF PROTON-INDUCED EFFECTS IN MICROELECTRONICS DEVICES

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In the summer of 1992, as part of the REU project of Alan Skees, modifications of the pion spectrometer beamline and target area were made to accommodate a portable dosimetry facility for the performance of radiation effects testing of microelectronics devices. This dosimetry end station houses a collimated secondary electron monitor (SEEM) of beam current, followed by a remotely insertable Faraday cup for SEEM calibration and a thin Kapton window through which the beam passes to irradiate the test device. An upstream spreader foil is used to achieve as large as a 7-cm diameter beam spot at the target location. The spot is uniform to better than 30% over the entire area and supports a maximum proton flux, limited by shielding, of about 10^{10} protons/s/cm^2. A personal computer and associated software, supplied by Ken Murray of KM Sciences, is used for control of the experiment and for dosimetry. An upstream beam stop is controlled by the computer to permit the experimenter to expose his device to a prescribed dose. Beam profiles are measured by exposure of chromographic films.

This dosimetry end station was assembled from existing hardware, using standard 4-inch Dependex vacuum fittings, on a movable beam support stand. It may, therefore be used in any of several target locations in the laboratory. This portability improves access to split beam time until the last splitter magnet is installed in late 1993. Bill Stapor of the Naval Research Laboratory has received funds for the design and fabrication of an improved version of the end station. Work on this will begin in the early fall of 1993.

While the end station was tested in the pion spectrometer area and the K600 beam line, it was used for production purposes only in a location about 5 feet downstream of the usual K600 target position, where it was employed for runs by three groups from Sandia National Laboratories. Single Event Effects (SEE) studies at elevated temperatures were performed with 30–60-pA proton beams by Ted Wrobel (paying user), who was testing to determine which of several possible devices was responsible for a failure on an actual satellite. Gerald Hash and Tom Calocci (paying users) performed total dose measurements on a number of devices. Jim Schwank (E362) also performed both SEE and total dose measurements on a number of devices. Copper degraders of various thicknesses were placed in air just in front of the test devices to change proton energies in the range from 30 to 180 MeV. In this way, an energy threshold was determined for Single Event Upsets for one device type.

This end station was also used in the K600 area for dosimetry associated with the irradiation of high-critical-temperature superconducting materials. The irradiation intro-

duces pinning centers that increase the magnetic field that may be trapped in the material. This work is being coordinated by Roy Weinstein (E361) of the University of Houston.

Radiation levels outside the K600 target room were found to be too high for routine use of this area for irradiations with beam intensities as high as about 300 nA, in particular with the geometries used in these experiments. Since there is continuing interest by the radiation effects testing community in proton tests at IUCF, and since there are PAC approved experiments for Weinstein and Schwank which require high proton fluxes, a study effort is presently underway to develop a design and a funding strategy for a properly shielded and instrumented facility to be built in the near future.